

CIPC-2,4-D COMBINATIONS FOR CONTROL OF
2,4-D-RESISTANT MONOCOT SPECIES

OCTOBER 1970 - NUMBER 25



BY

D. J. MORRE

R. D. CHEETHAM

JHRP

JOINT HIGHWAY RESEARCH PROJECT

PURDUE UNIVERSITY AND
INDIANA STATE HIGHWAY COMMISSION



Technical Paper

CIPC-2,4-D COMBINATIONS FOR CONTROL OF
2,4-D-RESISTANT MONOCOT SPECIES

TO: J. F. McLaughlin, Director
Joint Highway Research Project

October 28, 1970

File: 9-5-3

FROM: H. L. Michael, Associate Director
Joint Highway Research Project

Project: C-36-48C

The attached brief Technical Paper "CIPC-2,4-D Combinations for Control of 2,4-D-Resistant Monocot Species" has been prepared in part from research conducted under the HPR-1 (8) research Project "Research in Roadside Development", Part III Chemical Weed Control. Authors of the paper are D. J. Morre and R. D. Cheetham of the Department of Botany and Plant Pathology of the School of Agriculture.

The paper is presented to the Board as information and for approval of publication in the Proceedings of the North Central Weed Control Conference. The paper is planned for presentation at this Conference, December 8-10 in Lexington, Kentucky. The paper will also be forwarded to the ISHC and the FHWA for their review, comment and approval of publication.

Respectfully submitted,

Harold L. Michael

Harold L. Michael
Associate Director

HLM:ms

cc: F. L. Ashbaucher
W. L. Dolch
W. H. Goetz
W. L. Grecco
M. J. Gutzwiller
G. K. Hallock

M. E. Harr
R. H. Harrell
M. L. Hayes
E. M. Mikhail
R. D. Miles
J. W. Miller

C. F. Scholer
M. B. Scott
W. T. Spencer
H. R. J. Walsh
K. B. Woods
E. J. Yoder



Digitized by the Internet Archive
in 2011 with funding from
LYRASIS members and Sloan Foundation; Indiana Department of Transportation

CIPC-2,4-D COMBINATIONS FOR CONTROL OF
2,4-D-RESISTANT MONOCOT SPECIES

by

D. James Morre

and

R. D. Cheetham

Department of Botany and Plant Pathology
Purdue University

Joint Highway Research Project

Project: C-36-48C

File: 9-5-3

Prepared as Part of an Investigation

Conducted by

Joint Highway Research Project
Engineering Experiment Station
Purdue University

in cooperation with the

Indiana State Highway Commission

and the

U. S. Department of Transportation
Federal Highway Administration

The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the Federal Highway Administration.

Not Released for Publication

Subject to Change

Not Reviewed By
Indiana State Highway Commission
or the
Federal Highway Administration

Purdue University
Lafayette, Indiana
October 28, 1970

ABSTRACT

Laboratory, greenhouse and field studies show that CIPC pretreatments alter 2,4-D resistant monocot species making them susceptible to subsequent 2,4-D treatments. Pretreatment with 1 lb/A CIPC followed 1- several weeks later by 1 lb/A 2,4-D has given control of wild garlic (Allium vineale) and eradication of yellow nutsedge (Cyperus esculentus) along roadsides and in turf.

It is a basic tenet of weed science that grasses and grass-like plants (monocotyledons) are resistant to 2,4-D and related herbicides of the auxin type. However, when excised plant parts are incubated in solutions containing the growth regulator, both monocots and broad-leaved dicots respond to these materials to very nearly the same extent (2). On the basis of such laboratory findings, we reasoned that monocots could be killed with 2,4-D and related herbicides if enough of the herbicide were directed to critical cells and tissues. For the past several years, experiments in our laboratory have been concerned with developing techniques of 2,4-D application that might overcome the 2,4-D resistance of monocots and render them susceptible to 2,4-D.

Initially it was found that application of 2,4-D in dimethylsulfoxide (DMSO) was effective in providing control of liliaceous plants notably onion (Allium sepa) and wild garlic (Allium vineale) (3) in the greenhouse but not in the field. The ineffectiveness of 2,4-D in DMSO in the field was thought possibly due to the increased deposition of surface waxes and cuticle which characterize field-grown plants relative to greenhouse-grown plants. We reasoned that pretreatment with a carbamate herbicide to retard cuticle production (1) might facilitate expression of the desired 2,4-D plus DMSO synergism. Greenhouse studies in 1969-70 revealed that CIPC pretreatment of monocots did markedly alter their susceptibility to 2,4-D. However, the interaction could not be explained solely on the basis of cuticular or surface wax changes. It seemed to involve the creation of herbicide sinks in buds and other meristematic regions so that translocation and/or concentration of herbicide to these sinks was facilitated. The end result was that at least certain species normally resistant to 2,4-D were killed by 2,4-D at doses comparable to those providing control of broad-leaved dicots.



Materials and Methods

For greenhouse studies, wild garlic plants (Allium vineale) collected from the field near Lafayette, Indiana in February and March 1970 when the plants were 4-5 inches high were potted in 6-inch plastic pots. They were treated with 1/2-2 lb/A CIPC in 40 gpa water within several days after normal growth (ca. 0.5 inch/day) had resumed. 2,4-D (1 lb/A) in water or DMSO (40 gpa) was applied subsequently after 6, 8, 10 and 12 inches of growth. Rate of top kill was recorded and after 3 months the underground bulbs were recovered and examined. Surface waxes were determined according to Gentner (1). Greenhouse studies with yellow nutsedge (Cyperus esculentus) were conducted with plants collected in September and grown in metal pans or plastic pots (Table 2).

Field studies with wild garlic were located in Tippecanoe County, Indiana in a roadside situation. Plots were 12 x 20 feet in an overlapping, nonrandomized block design. Details of treatment were provided in Table 1. Growth rates of wild garlic in the field were comparable to those obtained in the greenhouse, at similar temperatures. Established yellow nutsedge growing in bluegrass turf was mowed to a height of about 4 inches on June 1. The following day, the plants were treated with CIPC as described in Table 3. The plants were again mowed and treated with 2,4-D (Table 3) on June 18.

Results and Discussion

Greenhouse studies showed that 2,4-D applied in DMSO killed top growth of wild garlic and reduced bulb development irrespective of CIPC treatment. However, at the 1/2 and 1 lb/A rates of CIPC the killing action of 2,4-D was enhanced. Plants receiving CIPC followed by 2,4-D were characterized by extensive cell division and enlargement of cells in below ground parts which resulted in a tumor-or callus-like appearance of bulb tissues. All 2,4-D treated plants produced predominantly soft, white bulbs in contrast to the hard, brown bulbs characteristic of untreated plants and plants receiving CIPC alone. CIPC alone appeared to have no detrimental effect on growth of wild garlic in the greenhouse and some antagonism with 2,4-D in terms of rate of kill of top growth was noted at the 2 lb/A rate. After 2 inches of growth, 2 lb/A CIPC caused a reduction of about 30% in amount of wax per plant with the 1/2 and 1 lb/A rates showing a similar reduction after 4 inches of growth. After 6 inches of growth all rates of CIPC were comparable giving about 40% reduction in surface wax. Effectiveness of the 2,4-D treatments decreased with increasing plant height and was most effective with plants less than 8 inches tall at the time of treatment.

In the field, all wild garlic plants receiving 2,4-D were deformed and chlorotic 6 weeks following treatment; the most effective treatments being those in which the foliage was crushed mechanically prior to application of 2,4-D (Table 1). In terms of control of top growth alone, the CIPC treatment had little or no effect (Table 1) and applications of 2,4-D in either water or DMSO were equivalent (data not shown). However, in those plants treated in the absence of mechanical damage, the



CIPC pretreatment had an effect (Table 1), but again it made no difference if the 2,4-D was applied in DMSO or not.

Irrespective of results with top growth, effective kill of bulbs by 2,4-D was dependent upon pretreatment of the plants with CIPC. In general, CIPC alone had no detrimental effect on bulbs. 2,4-D alone resulted in bulb damage but not enough to provide control. The combination of CIPC followed by 2,4-D caused extensively deformed bulbs which at the time of examination were decomposing and in many the roots were dead. In spite of the synergistic interaction of CIPC and 2,4-D, mechanical disruption of foliage was still necessary to achieve effective control of wild garlic with the combination (Table 1).

The basis for the CIPC followed by 2,4-D interaction remains elusive. Data obtained in the field do not confirm the greenhouse observations that CIPC pretreatment resulted in a significant reduction of surface waxes. Furthermore, neither CIPC pretreatment or mechanical injury resulted in an enhancement of 2,4-D activity by application in DMSO.

The CIPC-2,4-D interaction was shown most clearly in studies with yellow nutsedge. In the greenhouse, CIPC followed by 2,4-D resulted in nearly complete kill of top growth accompanied by proliferation of tissues at the base of the plant (Table 2). Since neither 2,4-D or CIPC alone had any measurable effect on nutsedge, these results show true synergism. The field studies with yellow nutsedge confirmed the greenhouse evaluations in that CIPC followed by 2,4-D proved to be effective as a control measure for this normally 2,4-D resistant monocot (Table 3). Evaluations 2 months and 4 months after treatment revealed no regrowth from the treated nutsedge plants whereas control plants were still

producing new growth. Bluegrass was not killed by the combination but we have no data on possible effects on growth rate. Greenhouse experiments with fescue suggest that while established grasses may not be killed at low rates by the CIPC-2,4-D combination, growth is retarded and the plants may show symptoms of 2,4-D injury.

References

1. Gentner, W. A. 1966. The influence of EPTC on external foliage wax deposition. *Weed Science* 14:27-31.
2. Morrè, D. J. and J. L. Key. 1967. Auxins. In: F. H. Wilt and N. K. Wessels eds., *Methods in Developmental Biology*. T. Y. Crowell Co., New York. pp. 575-593.
3. Morrè, D. J., W. R. Eisinger and H. W. Mussell. 1967. Tordon-2,4-D dimethylsulfoxide combination herbicides for use in roadside development. Report of Joint Highway Research Project, Purdue University and Indiana State Highway Commission. 32:1-67.



TABLE 1

Response of Wild Garlic (Allium vineale) to CIPC - 2,4-D combination treatments. Plants were pretreated March 22, 1970 at the 5-inch stage of growth with or without 1 lb/A CIPC followed by treatment on April 16 at the 7 1/2-inch stage of growth with or without 1 lb/A 2,4-D amine in 40 gpa water. Plants in one-half of each treated plot were flattened with a lawn rake to crush the foliage and mechanically rupture surface waxes and cuticle prior to 2,4-D treatment. Evaluations were made on May 28 approximately 6 weeks following the 2,4-D application. Values followed by the same letter are not significantly different.

<u>Pretreatment</u>	<u>Treatment</u>	<u>Plant Height, Inches</u>	<u>% Mature Plants With Flowers</u>	<u>Solid I° Bulbs</u>
None	None	22 a	100 a	100 a
	2,4-D	14 b	50 a	86 b
CIPC	None	22 a	100 a	96 a
	2,4-D	12 b	30 b	82 b
Foliage crushed prior to treatment with 2,4-D				
None	2,4-D	10 b	7 c	50 b
CIPC	2,4-D	9 b	8 c	0 c



TABLE 2

Effect of CIPC (1 lb/A) pretreatment and 2,4-D (1 lb/A) treatment 9 days later alone and in combination on the growth of established yellow nutsedge (Cyperus esculentus) in the greenhouse.

<u>Pretreatment</u>	<u>Treatment</u>	<u>Plants killed %</u>
None	None	10
None	2,4-D	10
CIPC	None	16
CIPC	2,4-D	75

Franchise	Year	Franchise Fee	Royalty	Other Fees	Total Fees
1. McDonald's	1990	\$45,000	4%	\$1,000	\$46,000
2. Burger King	1990	\$20,000	5%	\$500	\$20,500
3. Wendy's	1990	\$35,000	6%	\$1,000	\$36,000
4. Dunkin' Donuts	1990	\$15,000	6%	\$500	\$15,500
5. Pizza Hut	1990	\$25,000	7%	\$1,000	\$26,000
6. KFC	1990	\$30,000	8%	\$1,000	\$31,000
7. Little Caesars	1990	\$10,000	9%	\$500	\$10,500
8. Sizzurro	1990	\$18,000	10%	\$1,000	\$19,000
9. Oldemark	1990	\$12,000	11%	\$500	\$12,500
10. Dairy Queen	1990	\$8,000	12%	\$500	\$8,500

TABLE 3

Effect of CIPC (1 lb/A) pretreatment on June 1 and 2,4-D (1 lb/A) treatment on June 18 in water (40 gpa) on growth of established yellow nutsedge (Cyperus esculentus) in the field.

<u>Pretreatment</u>	<u>Treatment</u>	<u>Plant height after</u>		<u>Growth after</u>
		<u>1 week</u>	<u>2 weeks</u>	<u>2 months</u>
None	None	7	15	normal
CIPC	2,4-D	4	4	none





